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Epidemic Cerebrospinal Meningitis in China

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EPIDEMIC meningitis like some other diseases has been considered to be relatively less common in China than in the West. It was interesting therefore to discover that several epidemics have already been reported extending over a wide range of the country, and as scientific medicine becomes more general the disease will, we believe, be found as prevalent in China as elsewhere in the world.

PAST INCIDENCE IN CHINA

The most complete epidemiological data at hand are those of the Health Department of the Shanghai Municipal Council.¹

In 1898 Dr. Arthur Stanley reported 3 deaths in the foreign community, from acute meningitis. There were none in 1899, 1 in 1900, 2 in 1901, and 1 in 1902. From 1903 to 1917 no cases were reported. From 1918 to 1928 there were a few deaths annually, there being 76 in 1920. In 1929 came the severe epidemic with 1,099 reported cases and 403 deaths. In 1930 and 1931 there was a marked drop (Table I).

For Hongkong² my references go back only to 1909, and from that year

to 1917 no cases were reported. In 1918 came the great epidemic, followed in succeeding years by a gradually falling incidence (Table I). For Macao I have depended entirely on the report of the 1932 epidemic by Dr. Perigrino da Costa.³ Only a few scattering cases are reported from 1918 to 1931 (Table I).

The history of the disease in Canton is veiled in obscurity except in so far as hospital reports go. In my own experience in Canton there has never been a serious epidemic of the disease. However, a personal note from the city department of health declares that in 1930 there were 257 cases reported with 223 deaths, and in 1931, 77 cases and 9 deaths. One must question seriously the accuracy of these data, because inquiry at the various city hospitals during those years showed that only sporadic cases were seen (see also Table I under Canton Hospital).

Many cases of convulsions in children and tuberculous meningitis in adults have been erroneously diagnosed epidemic meningitis.

The National Epidemic Prevention Bureau's Monthly Returns by Provinces, which, though my files are very

TABLE I
INCIDENCE OF CEREBROSPINAL MENINGITIS
IN DIFFERENT CITIES 1918—1932

Year	Shanghai		Hongkong		Macao		Canton		Canton Hospital	
	Cases (Residents only)	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths
1918	13	1	1,232	968	4				1	1
1919		15	269	204					0	0
1920		76	158	103	6				4	2
1921		29	114*		2				0	0
1922		12	49*		2				6	4
1923		5	106*						0	0
1924		7	32*							
1925		6	64*							
1926		8	13*							
1927		1	26*							
1928		20	21	16						
1929	1,099	403	25	20					3	0
1930	329	201	20	13	1				1	1
1931	292	174	25	16					5	2
1932	107	59	207	122	600	58%	174	36	31	9

* These figures were obtained from Dr. da Costa's Report on Macao, p. 8, and not from the Hongkong Sanitary Reports.

incomplete, report the disease from all of the 18 provinces except Kansu, from which many data are lacking.

PREVIOUS EPIDEMICS IN CHINA

Attention was first forcibly drawn to the occurrence of the disease in China by the Hongkong epidemic of 1918.^{4, 5} The first case was reported February 9, but there had probably been cases in January. The maximum incidence occurred in March, after which there was a rapid decrease during April. There were reported 1,232 cases with a mortality of 76 per cent. During this period no cases were officially reported in Canton, but during the year there

was 1 fatal case admitted to the Canton Hospital.

The next important epidemic was that reported by Stevenson and Tang,⁶ who reported 700 to 800 cases occurring in Luchowfu, Anhwei Province, in 1919-1920. The maximum incidence was in February and March, a sudden change from warm to cold weather, with rain, causing a definite increase. Chief reliance was placed on spinal puncture, the average number per patient being only 3, while many had only 1. The mortality of untreated cases was estimated at 40 per cent; of the treated cases only 5 per cent.

A third important epidemic occurred

in Shanghai in 1929.⁷ It reached its height in the third week of April and there was a mortality rate of 46.4 per cent.

MENINGITIS IN 1932

When news came of the epidemic in Macao, many inferred that it had been carried by the thousands of refugees who poured into Macao, Hongkong, and Canton following the Japanese attack upon Shanghai. I therefore wrote to the Commissioner of Public Health of

the Shanghai Municipal Council, who replied June 9, 1932:

I have to state that in my opinion cerebrospinal fever has not been epidemic in Shanghai this year. . . . In regard to meningitis as a whole, it may be of interest to note that there is clear evidence this disease is not usually spread from Shanghai, but spreads to it from surrounding districts, or at any rate this was so during the last epidemic. . . . In regard to the theory that refugees from Shanghai spread meningitis over other portions of the country, I have to state that I cannot see any grounds for this at all. For some reason or other the theory that Shanghai

CHART A—Weekly incidence of meningitis at Macao, 7 Canton hospitals, Hongkong, and Shanghai—January 1 to July 2, 1932

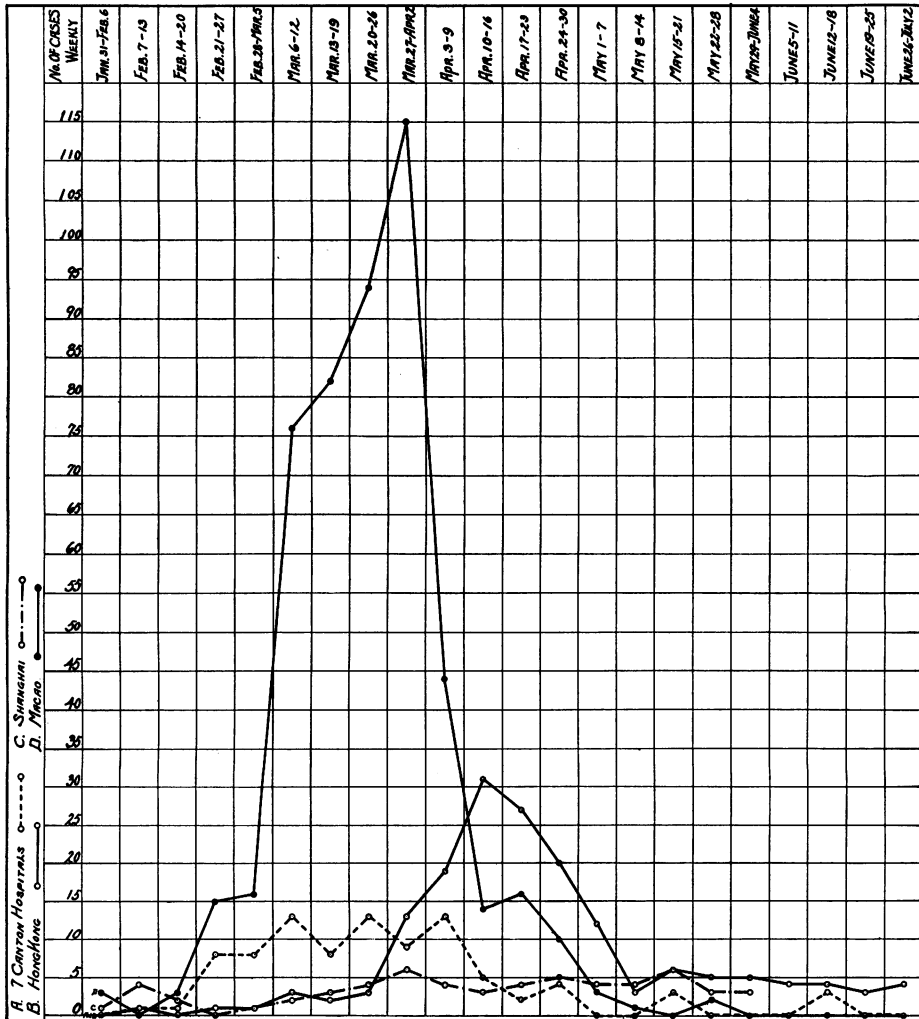
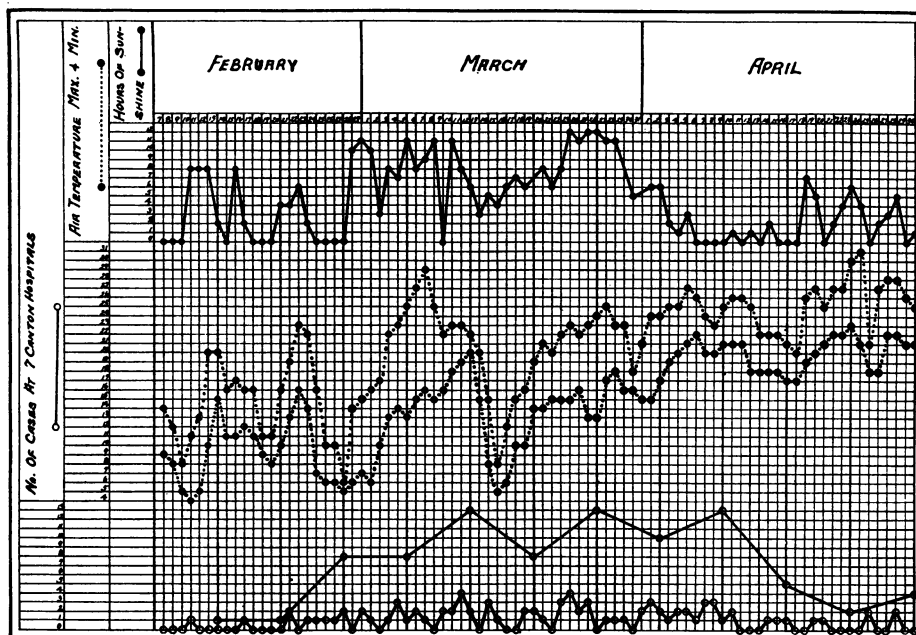


TABLE II
INCIDENCE OF MENINGITIS IN 4 CITIES IN 1932

Time Period	Canton		Hongkong	Shanghai	Macao
	Health Dept	7 Hospitals			
Jan. 1-30	6	4	5	12	1
Jan. 31-Feb. 6	2	0	0	1	3
Feb. 7-13	1	1	1	4	
Feb. 14-20	0	1	0	2	3
Feb. 21-27	0	8	1	0	15
Feb. 28-Mar. 5	1	8	1	1	16
Mar. 6-12	7	13	3	2	76
Mar. 13-19	7	8	2	3	82
Mar. 20-26	11	13	3	4	94
Mar. 27-Apr. 2	14	9	13	6	115
Apr. 3-9	9	13	19	4	44
Apr. 10-16	30	5	31	3	14
Apr. 17-23	18	2	27	4	16
Apr. 24-30	12	4	20	5	10
May 1-7	9		12	4	3
May 8-14	7		3	4	1
May 15-21	7	3	6	6	
May 22-28	0		5	3	2
May 29-June 4	1		5	3	
June 5-11	4		4		
June 12-18	4	3	4		0
June 19-25	2		3		
June 26-July 2	0		4		
July	14	3	5		1
August	3	1	7		1
September	3	1	5		1
October	0	0	3		1
November	1	0	7		0
December	1	1	8		0
Totals	174	101	207	71	499

CHART B—Hours of sunshine, maximum and minimum temperature (Centigrade) compared with the daily and weekly incidence of meningitis at 7 Canton hospitals during February, March, and April. Estimation is made as of day of onset of the disease.



acts as a reservoir for communicable diseases is a favorite one but is not, in my view, supported by evidence.

From January 2 to June 4, 1932, there were only 71 cases reported from Shanghai by the Commissioner of Health, among the resident population, although 58 additional cases among the non-resident population had occurred.

In Macao meningitis assumed truly epidemic proportions a detailed report of which has been prepared by Dr. P. J. Peregrino da Costa.³ By referring to Table I it will be noted that no epidemic had been previously recorded in the colony. The origin of the 1932 outbreak is unknown, but the disease was rampant in some of the country towns of the neighboring district of Chung Shaan. He suspects that refugees from North China, passing through Macao, brought the disease. The second case was a boy, who had

arrived 2 days previously from his native village. Other early cases apparently contracted the disease in Macao. Altogether some 600 cases occurred, in a population of over 100,000, but only 503 were proved.

In Hongkong 207 cases were reported, but the origin of the first cases has not been determined.

With regard to Canton, the data are, of course, far less reliable, and we have collected statistics from several of the leading hospitals in the city in addition to the cases reported by the health department. That these latter figures are only in part reliable is proved by the excessive numbers reported in 1930, when there was no epidemic apparent to workers in the different city hospitals.

For the 1932 epidemic I prepared a questionnaire which was distributed to the chief hospitals in Canton and vicinity. Data were asked for as to the

number of patients seen, with time of onset, duration of disease, and result; also age and sex of patients, number of spinal punctures made, cell count of spinal fluid and white blood cell count, amount of serum given, the occurrence of meningococci, and the presence of Kernig's Sign, headache, stiff neck, eruption, convulsions, and delirium; what measures appeared to be most beneficial in treatment, *i.e.*, spinal puncture, serum and others, and the origin of the epidemic.

Satisfactory replies were received from Canton Hospital, First Sun Yat Sen, David Gregg, Kwong Wah, Leung Kwong, and Kong Tsuen Hospitals. Brief statements were obtained from the Municipal Hospital and Dr. Todd.

From this information and the data from the Health Department, we are able to give the incidence of the Canton epidemic in relation to its appearance in other cities.

By reference to Tables II and III and to the Chart A, one can note that the epidemic appeared first in Macao, beginning in February, reaching its peak in March, and subsiding in April, after which month hardly any cases appeared. The same was practically true of those reported in 7 Canton hospitals where many cases occurred from March 6 to April 16, whereas the Canton Health Department showed the maximum about the middle of April. Cases are reported a week or more after their entrance to the hospitals, and for the 7 hospitals the time was estimated from the day of onset.

The Hongkong Health Department reports a maximum incidence in the middle of April, gradually diminishing in May and June. Thus the disease began in Macao, and was followed a little later by an outbreak in Canton, and the following month in Hongkong. In Shanghai the disease was never very prevalent, but in April and May the highest incidence occurred.

METEOROLOGICAL CONSIDERATIONS

Olitsky⁵ in his description of the 1918 epidemic in Hongkong states that the temperature had a marked influence on the incidence of the disease. When there occurred a sudden drop in the temperature the number of cases increased, and *vice versa*—the increase occurring about 4 days later. The influence of sunshine was also noted, a lack of it being followed by an increased incidence in the disease. Humidity and rainfall had little influence.

da Costa,³ in the 1932 epidemic in Macao, noted that whenever there occurred a pronounced difference between maximum and minimum temperatures on any given day, the number of cases increased after a few days, and concludes that humidity, rainfall, and lack of sunshine have little bearing on the incidence of the disease.

For the Canton cases we have charted (Chart B) the daily and weekly incidence, together with the daily records for hours of sunshine and maximum and minimum temperature, obtained at the Freeman Meteorological Observatory, Lingnan University. The week ending February 27 showed the first decided rise in incidence, following 4 sunless days and a precipitous drop in the temperature to 4°. A week later the temperature rose and there were several sunshiny days. The incidence remained the same. In April there were 2 weeks of sunless days, but moderate temperatures were followed by a gradual decline.

In February there were 12.99 cm. of rain, in March 9.9 cm. and in April 13.41 cm. The average humidity in February was 68 per cent, in March 79 per cent and in April 87 per cent.

The latitude of Shanghai is between 31° and 32° N. The latitudes of Canton, Hongkong, and Macao lie between the Tropic of Cancer and 22° N.

The available data do not reveal any striking correlation between the mete-

TABLE III
INCIDENCE OF DISEASE ACCORDING TO MONTHS IN 4 CITIES 1932

Month	Canton Health Dept.	Seven Canton Hospitals	Shanghai (Residents only)	Hongkong	Macao
Jan.	6	4	12	5	1
Feb.	3	10	7	2	23
March	26	46	10	9	355
April	83	28	22	110	117
May	23	4	17	26	5
June	11	3	39	16	0
July	14	3		9	1
Aug.	3	1		7	1
Sept.	3	1		5	1
Oct.	0	0		3	1
Nov.	1	0		7	0
Dec.	1	1		8	0
Totals	174	101	107	207	505

orological conditions and the rise and fall of the epidemic.

Sex—In the 7 hospitals there were 107 patients whose sex was reported. Of these 60, or 56 per cent, were males, and 47, or 44 per cent, females. In Macao 59 per cent and in Hongkong 65 per cent were males. At the Canton Hospital, of the 31 cases treated 71 per cent were males.

Age—The ages were recorded in 84 patients in 5 general hospitals in Canton: 10–20 years, 40 cases; 21–30 years, 21 cases; under 10 years, 19 cases (1 under 6 months); 31 and over, 4 cases.

It will be noted that nearly one-half of all the cases occurred in the 2nd decade, and one-fourth in the 3rd. Most of the remainder were under 10 years, but few were infants.

At Macao, most of the patients were under 10, but the 10–20 year group

were nearly as numerous. In the 3rd decade there were less than one-half the number in the 2nd, and in the 4th decade about one-half those in the 3rd. There were few over 40 years of age.

In the Hongkong epidemic of 1918, the peaks of the curve of incidence, according to age, were from infancy to 5 years and at 17½ years of age.

Duration of Illness—Most of our cases at Canton Hospital as well as in other hospitals were brought in on the 2nd to 4th day of illness, and all cases

TABLE IIIA

<i>Duration of Illness</i>	<i>Number of Cases</i>
2–5 days	26
6–10 days	28
11–15 days	10
16–20 days	15
21–30 days	10
31–40 days	5
41–50 days	3
over 50 days	7

had been ill more than 24 hours. Taking the records of 7 Canton hospitals, the total days of illness are distributed as shown in Table IIIA.

The periods of 6 to 10, and 2 to 5 days, were the most usual; 9 cases each were ill 4 and 6 days. One patient was reported as cured after 87 days, and 1 of the Canton Hospital cases suffered a relapse, but finally recovered after 46 days. We may say that recovery usually requires from 1 to 3 weeks.

Death usually occurred in less than a week after the onset.

MORTALITY STATISTICS

The death rate varies enormously in different epidemics.

In the Anhwei cases⁶ the mortality was estimated as 40 per cent for untreated cases and 5 per cent when a simple spinal puncture was performed. In the 1918 Hongkong epidemic the mortality was 76 per cent in spite of serum treatment and spinal puncture. In Shanghai, 1929, there were 46.4 per cent deaths. In 1932, Macao reports a death rate of 59 per cent in the 491 cases which entered the Isolation Hospital. The Medical Department of Hongkong reports a mortality rate of 58 per cent in 1932, while Shanghai had a death rate among residences of the settlement of 55 per cent. The Canton Health Department reported 21 per cent deaths.

In 6 of the Canton Hospitals, from January until June, including the period of the epidemic we have:

	<i>Number of Cases Deaths</i>	
Canton Hospital	26	5
Sun Yat Sen	26	12
Kwong Wah	14	4
Leung Kwong	14	7
Municipal	6	2
Totals	86	30 = 34 + %

These cases were nearly all verified bacteriologically.

The death rate among later sporadic cases was greater than during the epidemic. At Canton Hospital there were 6 cases from June to September with 4 deaths.

Most fatal cases had been sick but a few days before admission and did not live long. Of 34 deaths in 5 hospitals, 11 had been sick 1 day before admission, 5, 2 days, and 7, 3 days. There were 2 each who had been sick for 4, 5, 6, and 7 days, 1 for 10 days, and 2 for over 14 days.

In Macao of 290 deaths, 63 died on the day of admission and 112 from the 2nd to the 5th day.

Spinal Puncture—This was always done in the lumbar region. It was usually done only once a day, and as symptoms abated, every other day or less frequently, depending on the temperature, the number of cells in the spinal fluid, headache, stiffness of the neck, etc.

At Canton Hospital no case was diagnosed epidemic meningitis unless a spinal puncture had been made and purulent fluid obtained. During the height of the epidemic a child was brought in with high fever, a very stiff neck, and severe headache. Spinal puncture was done and clear fluid obtained under increased pressure. The cell count was not increased. The next day the child showed typical signs of mumps, from which he made an uninterrupted recovery.

One case was punctured 16 times in 51 days and made a good recovery. A sporadic case was punctured 25 times during 41 days and also recovered. In the other Canton hospitals 18 was the highest number of punctures made, 2 or 3 being usual.

In the writer's opinion this procedure is by far the most important means of relieving symptoms and bringing about a cure. Dr. Valentine of Hongkong writes: "No improvement was observed in any case, unless lumbar punc-

ture had been performed." Dr. S. W. Phoon of Tung Wah Hospital, Hong-kong, reported that an average of 5 punctures were done per case when treatment was started early.

Spinal Fluid—The spinal fluid in true epidemic meningitis sooner or later becomes cloudy, due to the large number of leucocytes. This is important in the differential diagnosis from tuberculous meningitis, so common in South China. The number of cells, is, we believe, of definite value in determining the progress of the disease and as an indication for further punctures. In 24 of our cases diagnosed epidemic meningitis, meningococci were found. In these the maximum cell count was 3,900, and the minimum 730—average of 1,000 to 2,000. At the Kwong Wah Hospital counts of 15,000 to 18,000 were made. At the Sun Yat Sen Hospital, counts varied in positive cases from 32 to 5,120 cells.

The white blood cell count was invariably raised in the acute cases. In 5 hospitals there were 68 cases in which meningococci were demonstrated and in whom a leucocyte count of the blood was made. Deaths in these cases are shown in Tables IV and V.

TABLE IV

<i>No. of W.B.C. in Blood</i>	<i>No. of Cases</i>	<i>No. of Deaths</i>	<i>% Deaths</i>
9,000 or under	3	3	100%
10,000–14,000	28	6	21%
15,000–19,000	21	9	43%
20,000 and over	16	5	31%

The lowest white count, 7,600, was in a fatal case in whom meningococci were not found. One malignant fatal case had a leucocyte count of 38,000 cells and the spinal fluid was blood-tinged, but contained no meningococci. Of the positive cases the highest leucocyte count was 36,000, and this patient recovered.

We conclude that a white blood cell count of 10,000 to 14,000 is most

favorable; a lower count is very grave, and one above 15,000 is serious, but not so bad as the lower count.

OCCURRENCE OF MENINGOCOCCI

Naturally the presence of the organism in the spinal fluid is essential for making an absolute diagnosis of epidemic meningitis. On the other hand, it might be assumed that a case belonged to the epidemic variety: (1) when the spinal cell count exceeded 500; (2) when no other organisms could be found; (3) if the case recovered; in spite of the fact that repeated smears of spinal fluid failed to show the intracellular diplococci.

Thus a positive diagnosis was justifiable in several negative cases. Table V shows the percentage of positive cases in each hospital, judged by presence of meningococci.

TABLE V

<i>Hospital</i>	<i>No. of Cases</i>	<i>No. Positive</i>
Canton Hospital	31	24
Sun Yat Sen	23	19
Kwong Wah	14	14
Leung Kwong	14	13
David Gregg	13	8
Kong Tsuen	3	3
Total	98	81

About 83 per cent of the cases showed a positive bacteriological finding. In 1 of the hospitals all cases were positive. At Canton Hospital 17 per cent had a positive spinal fluid. In negative cases a search was made for the tubercle bacillus and pus forming organisms, without results, though there were, during 1932, several cases diagnosed tuberculous meningitis, in which the spinal cell count was relatively low and tubercle bacilli were demonstrated, or else no organism was found. All ended fatally.

CLINICAL SIGNS

The occurrence of the common clinical signs is recorded in Table VI.

It will be noted that of the 97 cases in 7 hospitals, 90 were reported with Kernig's sign, but it has been our observation that this is practically always present in genuine cases.

Delirium was recorded in 69 cases, but in 4 the absence was questionable. When a patient is at all conscious, stiffness of the neck is generally present.

Eruptions were conspicuous by their absence. Four cases with purpura were seen at the Sun Yat Sen Hospital, and 18 altogether in the series.

In Macao 50 per cent of the hospitalized cases had convulsions or delirium. There was only 1 case with a purpuric eruption.

Dr. S. W. Phoon reported on 75 cases observed at Tung Wah Hospital in Hongkong and states that Kernig's sign was present in all. Delirium and convulsions were rare, stiff neck was common.

TREATMENT

The one form of treatment of undisputed value is frequent lumbar puncture. Various palliative remedies for

control of restlessness and pain are of course to be utilized.

Serum was generally employed in our patients, but the actual benefit from its use may be questioned. The number of spinal punctures varied from 1 to 25. The amount of serum at each dose varied from 10 c.c. to 40 c.c.—usually 20 c.c.—the total amount from 10 c.c. to 285 c.c.

Thus the majority of patients treated in Canton were given one form or another of antimeningococcic serum. I have found none of the Canton doctors very enthusiastic over its therapeutic value, aside from the effect of spinal puncture alone. The sera used were all polyvalent.

SUMMARY

1. Epidemic cerebrospinal meningitis first manifested itself in China in epidemic form at Hongkong in 1918. It became more severe in the 4th week of March and continued to be prevalent until the 2nd week of May. Other epidemics have been reported from Anhwei in 1920 and Shanghai in 1929.

TABLE VI
CLINICAL SIGNS

Name of Hospital	Cases Reported	Kernig's Sign	Headache	Delirium	Stiff Neck	Convulsions	Eruption	
Canton Hospital	31	27	29	17	27	6	1	
Sun Yat Sen	23	23	23	16	17	3	5	4 <i>purpura</i>
Kwong Wah	14	11	13	10	11	9	2	
Leung Kwong	14	14	14	11	14	8	5	
Municipal	6	6	6	6	6	6	4	
David Gregg	6	6	6	6	6	3	0	
Kong Tsuen	3	3	3	3	3	3	1	
Totals	97	90	94	69	84	38	18	

2. In 1932 the disease appeared in Macao in epidemic form for the first time in the 4th week of February. It reached its height in March, subsiding during April, and practically ceased early in May.

3. For Canton, according to Health Department statistics, the disease began to increase in the 1st week of March, and continued to be prevalent until the middle of May. Reports from 7 Canton hospitals indicate that the epidemic began in the 3rd week of February and lasted till the end of April.

4. The meteorological conditions in Canton seemed to have little effect on the epidemic.

5. Spinal puncture is essential for accurate diagnosis. It is the most effective therapeutic measure available.

6. Polyvalent anti - meningococcic

serum was generally employed intravenously, intramuscularly, and subcutaneously. No especial advantage was noted for these latter methods over the intrathecal. Several brands of serum were employed with no particular preference for any one.

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Johann Peter Frank

DIFFICULT as it is to make a critical study of as vast a work as the "Medizinische Polizey" it is yet more difficult to write an appreciation of it. Although the "System" is judged to be the first modern comprehensive attempt to codify the details of public health administration, little attempt has been made to trace what influence it may have had on the subsequent history of public health. To judge whether Frank was more than a curiosity, a man whose ideals were thoroughly modern but who had little influence, is a major problem in itself. The analyses of his ideas given in this paper can make possible such an evaluation.

To elaborate praises of Frank's penetrating thought, his vision, and his scholarly treatment of his subject would be useless. If these things do not speak for themselves no one can speak for them. To assume a condescending

air and smile at his faith in the power of legislation, his inclusion of much superstition and prejudice with the more enduring matter of his discussion, would be equally useless. Kratter¹ in 1888 made an observation which will perhaps serve better as epilogue than anything else which could be said:

If anyone has leisure and desires to refresh himself with a language which has not yet buried thought beneath a professional idiom but still conveys it without embarrassment or reservation, and if anyone enjoys a frank delineation of social conditions—let him read Frank.—By Leona Baumgartner and Elizabeth Mapelsden Ramsey, *Annals of Medical History*, Vol. 6, No. 1 (Jan.), 1934, p. 83.

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